REMARKS

The above amendments to the above-captioned application along with the following remarks are being submitted as a full and complete response to the Official Action dated February 19, 2004. In view of the above amendments and the following remarks, the Examiner is respectfully requested to give due reconsideration to this application, to indicate the allowability of the claims, and to pass this case to issue.

Status of the Claims

Claims 1, 6-12 are under consideration in this application. Claims 1 and 6-9 are being amended, as set forth above, in order to more particularly define and distinctly claim Applicants' invention.

Additional Amendments

The claims are being amended to correct formal errors and/or to better disclose or describe the features of the present invention as claimed. Applicants hereby submit that no new matter is being introduced into the application through the submission of this response.

Formality Rejection

Claim 9 was objected to for one informality, claim 1 was rejected under 35 U.S.C. §112, first paragraph, for not being enabled by the specification, and claim 7 was rejected under 35 U.S.C. §112, second paragraph, for being indefinite. As indicated, the claims have been amended as required by the Examiner. Accordingly, the withdrawal of the outstanding informality rejection is in order, and is therefore respectfully solicited.

Prior Art Rejections

Claims 1, 6, ,8, 9, and 12 were rejected under 35 U.S.C. § 103(a) on the grounds of being unpatentable over U.S. Pat. No. 4,568,149 to Suguta et. al (hereinafter "Suguta") in view of JP 3-54523 to Nomoto et. al. (hereinafter "Nomoto"), and claims 10-11 were rejected further in view of JP 63-223728 to Tanaka et. al. (hereinafter "Tanaka"). The prior art reference Tatemichi at. al. (JP 3-287-127) was cited as being pertinent to the

present application. These rejections have been carefully considered, but are most respectfully traversed.

The liquid crystal display device according to the invention (page 26, line 26 ~ page 29, line 17; Figs. 6A, 6B, 7, 8, 9A-9D), as now recited in claim 1, comprises: a first substrate ***100 B*** on a main surface thereof, a black mask ***3*** and color filters ***2***, each arranged in an aperture of the black mask ***3***(page 10, line 24 ~ page 11, line 3*)*, being formed; a liquid crystal layer ***9***; a second substrate ***100A*** disposed opposite to the first substrate across the liquid crystal layer ***9*** and stuck to the first substrate ***100 B*** by a sealing material (page 23, lines 6-22) applied to peripheries of a main surface of the first substrate ***100B*** facing the liquid crystal layer ***9*** and of a main surface of the second substrate ***100A*** facing the liquid crystal layer ***9***; a stacked structure (page 4, line 25 ~ page 5, line 22) formed on the main surface of the second substrate ***100A*** by stacking in order first signal lines ***102***, ***104***, an insulating film ***105*** covering the first signal lines ***102***, ***104***, and second signal lines ***103*** each overlappingly intersecting the first signal lines ***102***, ***104*** over the insulating film ***105*** therebetween; and first spacers ***1b*** and second spacers ***1c*** both formed on the main surfaces of the first substrate ***100B*** as well as arranged on the black mask ***3*** and in the liquid crystal layer ***9*** (e.g., Fig. 6).

In particular, each of the second spacers ***1c*** is ordinarily spaced from the stacked structure formed on the second substrate ***100A*** to accommodate the liquid crystal layer ***9*** therebetween ("*The spacer 1c formed at the position shown in FIG. 6B ordinarily is not in contact with the TFT substrate 100A, but if a force perpendicular to both substrates is applied from the outside, the spacer 1b shown in FIG. 6A is pressed and elastically deformed, so that the gap between the TFT substrate 100A and the color filter substrate 100B becomes narrow and the spacer 1c also comes into contact with the TFT substrate 100A and bears the load.*" P. 9, lines 8-14), and each of the first spacers ***1b*** ordinarily contacts directly with the stacked structure formed on the second substrate ***100A*** ("*the spacer 1b formed at the position shown in FIG. 6A is ordinarily placed in contact with the TFT substrate 100A, and works to form and maintain the gap between the TFT substrate 100A and the color filter substrate 100B*" p. 29, lines 5-8). The spacers are interposed in the gap between a pair of insulating substrates in which a liquid crystal compound is sealed, in order to hold the gap at a predetermined value (p. 2, last paragraph).

The invention applies two kinds of spacers denoted by the reference numerals ***1b*** and ***1c*** coexisting on the black mask ***3*** formed on the first substrate ***100B*** and face the stacked structure formed on the second substrate ***100A***. The first spacers ***1b*** and the second spacers ***1c*** of the invention may be formed on/above the black mask ***3*** by drying the dropped aqueous solution type of resist material 13 then removing unnecessary portions (p. 30, line 20 – p. 31, line 24; Figs. 10A-10C). Therefore, the invention does not <u>internally/deliberately</u> apply "any external force" to press the first and second spacers ***1b, 1c*** against the black mask ***3*** in the **ordinary** situation. Rather, the invention tried to cope with "an external force" <u>accidentally/undesirably</u> applied to the liquid crystal display device (p. 26, line 26 – p. 28, line 10; p. 3, line 18 – p. 4, line 16). For example, the <u>spacing-maintaining spacers 1b</u> provided corresponding to " *the intersection of the drain signal line 103 and the counter voltage signal line 104*" in the stacked structure (page 27, line 9-11; FIG. 6A) are ordinarily contacts with the TFT substrate 100A to maintain the gap between the TFT substrate 100A and the color filter substrate 100B. The <u>load-bearing spacers 1c</u> provided only "*over the drain signal line 103*" but not over the counter voltage signal line 104 (i.e., only over one set of signal lines but not any overlappingly intersecting positions of the two sets of signal lines in the stacked structure, page 27, line 14; FIG. 6B) ordinarily do not contact with the TFT substrate 100A, but if an external force perpendicular to both substrates is applied, the spacers 1b are pressed and elastically deformed, so that the gap between the TFT substrate 100A and the color filter substrate 100B becomes narrow and the spacers 1c also come into contact with the TFT substrate 100A to bear the load. Within one liquid crystal panel, by selecting positions where to form such spacers, it is possible to appropriately adjust the number of spacers 1b and spacers 1c, whereby it is possible to realize a liquid crystal display device which can cope with perpendicular or horizontal external forces relative to its liquid crystal panel without any problem (page 27, line 21 to page 28, line 10). As such, any positional deviation of the second substrate ***100A*** to the first substrate ***100B*** caused by an external force is absorbed by the cooperation between the first spacers ***1b*** and the second spacers ***1c***.

None of the cited prior art references teaches or suggests such "one group of spacers ***1c*** <u>ordinarily</u> spaced from the stacked structure formed on the second substrate ***100A*** to accommodate the liquid crystal layer ***9*** therebetween, while another group of

spacers ***1b*** <u>ordinarily</u> contacting <u>directly</u> with the stacked structure formed on the second substrate ***100A***" as recited in claim 1.

In contrast, Sugata disposes uniformly-thick spacer members ***6a, 6b, 6c, 6d*** on an insulating layer coating over non-transmissive members ***12*** ("*by forming a <u>uniform</u> film ... by vapor deposition, sputtering coating or the like* (col. 5, lines 44-50);" Col. 5, lines 2-4; Fig. 3(b)) as well as processes the spacer members in the same procedures together such that ALL spacers <u>ordinarily</u> contacting <u>directly</u> with the stacked structure formed on the second substrate. (Fig. 4(b)). Sugata simply does NOT have a group of spacers ***1c*** <u>ordinarily</u> spaced from the stacked structure formed on the second substrate ***100A*** to accommodate the liquid crystal layer ***9*** therebetween.

Sugata intends to overcome drawback (c) of the conventional structure (col. 7, lines 5-10; Figs. 1 and 2) with the uniform spacer members. "*(c) Since the seal member is readily deformable, the distance of the gap between electrode plates locally varies in a display cell. As a result, there often occurs lack of uniformity in display characteristics. The distance of the gap between electrode plates in a display cell is apt to change.*" Clearly, Sugata discourages: (i) using readily deformable material as spacers to keep a gap between electrode plates (substrates) uniform in which a liquid crystal layer is sealed, and (ii) allowing the gap between the electrode plates to vary locally. On the contrary, the invention deliberately allows the first spacers ***1b*** contacting directly with the second substrate ***100A*** in the **ordinary** situation to be deformed by an external force, and then letting the second spacers ***1c*** spaced from the second substrate ***100A*** contacting the second substrate ***100A*** after the first spacers ***1b*** being deformed. As such, Sugata teaches away from the invention. It is well established that a rejection based on cited references having principles that teach away from the invention is improper.

Nomoto's spacers 3 were relied upon by the Examiner to teach a group of spacers spaced from the stacked structure formed on the second substrate to accommodate the liquid crystal layer therebetween. However, Applicants contend that Nomoto's spacers 3 are spaced from the stacked structure formed on the second substrate (Figs. 1-2) only <u>before</u> the sealant 4 is cured. Nomoto's spacers 3 contact the stacked structure formed on the second substrate (Fig. 3) after the sealant 4 is cured (i.e., the ordinary state of the liquid crystal display device).

In addition, Nomoto uses 3 (three) kinds of spacer materials ***3, 5, 7*** for spacers between an electrode substrate ***1*** and a counterpart substrate ***2***, a first group of spacers ***3*** are disposed within a space surrounded by the sealant ***4***, a second group of spacers ***5*** are mixed in the sealant ***4***, and a third group of spacers *7* are mixed in a temporary fixing material ***6*** provided outside the sealant ***4***. Nomoto only has ONE group of spacers ***3*** disposed in a liquid crystal layer, rather than TWO groups of spacers as the invention.

Nomoto tried to solve prior art manufacturing problem of fixing two electrodes substrates with a temporary fixing material containing a spacer material having the same size as the other spacer material mixed with the sealant (p. 2, lines 17-29 of the translation).

> "*In the case where into the temporary fixing material is mixed a spacer material having the same size as the spacer material mixed with the sealant, however, when the temporary fixing material is cured as pressure is put on the parts of the electrode substrates near the temporary fixing material, and then pressurization is removed, rebound force acts due to elasticity of the temporary fixing material, resulting in that the size of the temporary fixing material becomes larger than the size of the spacer material in which sealant is mixed.*
>
> *Consequently, when the whole of both electrode substrates is pressurized and the sealant is cured in such a state, <u>the size of the clearance gap between both electrode substrates near the temporary fixing material is still larger than the size of the spacer material mixed with the sealant, which causes the problem of gap failure</u>.*"

To overcome such a problem, Nomoto provides the spacers **7** smaller than the spacers **5** mixed with the sealant **4**, or which becomes smaller when being pressurized and cured in the temporary fixing material **6** (p. 3, line 21 – p. 4, line 19 of the translation).

> "*In Fig. 1, **1** is an electrode substrate, and **2** is the counterpart substrate. Two substrates **1, 2** are disposed opposite to each other so that between them are <u>a spacer material 3 of a picture element part</u>, a sealant **4**, a spacer material **5** mixed with the sealant **4**, a temporary fixing material **6** and a spacer material 7 mixed with the temporary fixing material **6**. In the drawing, the electrode substrate **1** and the counterpart substrate **2** are superposed one over the other, and then load **P1** is applied to the part of the counterpart substrate **2** near the temporary fixing material **6**. When the load **P1** is applied, the temporary fixing material **6** is compressed so that the spacer material 7 mixed with the temporary fixing material **6** engages with the temporary fixing material **6**. Although the picture element part to which load is not applied is engaged by the sealant **5**, it can't be sufficiently compressed.*

*In such a state, the temporary fixing material **6** is cured, and when the load **P1** is eliminated as shown in Fig. 2, the rebound force due to elasticity of the temporary fixing material **6** acts on the counterpart substrate **2**, so that the above part of the counterpart substrate **2** is raised. However, <u>spacer material 7 which was smaller than the size of the spacer material 5 mixed with the sealant 4 or which has become smaller was previously mixed with the temporary fixing material 6</u>, so <u>a clearance gap equal to the size of the spacer material 5</u> mixed with the sealant **4** <u>is maintained between the part of the counterpart substrate 2</u> which has expanded in size <u>and the electrode substrate 1</u>.*

*Subsequently, when <u>load **P2** is applied to the picture element part</u> to cure the sealant **4** as shown in Fig. 3, the sealant **4** is compressed to engage the spacer material **5** mixed with sealant **4**. As a result, <u>the height of the temporary fixing material 6 is the same as the size of the gap of the picture element part or a little smaller than it</u>.*

<u>Thus, the gap failure</u> caused by the temporary fixing material 6 as in the prior art <u>can be prevented</u>. "

Nomoto makes *<u>the height of the temporary fixing material 6</u>* be **equal to** or **a little smaller than** *<u>the gap of the picture element part</u>* (where the first group of spacers ***3*** are disposed) to prevent *<u>the gap of the picture element part</u>* from being too broad (wide). The first group of spacers ***3*** contact with the counterpart substrate ***2*** after *<u>the picture element part</u>* is released from the aforementioned *<u>load **P2**</u>* applied thereto in the step for curing *the sealant **4***.

Tanaka's first spacers 25 and second spacers 26 were relied upon by the Examiner to teach one group of spacers formed on top of a base pattern in the black mask while the other group of spacer nor being formed on the base pattern. However, only has ONE group of spacers ***26*** disposed in a liquid crystal layer, rather than TWO groups of spacers as the invention.

Tanaka applies 2 (two) kinds of spacers ***25, 26*** for a liquid crystal display device: the <u>first group of the spacers ***25***</u> <u>formed of **glass fiber**</u> and dispersed in a sealant ***24***, and the <u>second group of the spacers ***26***</u> being <u>**plastic spherical beads**</u> dispersed to stick the substrates ***21, 28*** to each other with a space (a display screen area ***23***) therebetween surrounded by the sealant ***24***.

In addition, Tanaka fails to compensate for the above-mentioned deficiencies of Nomoto in that it does not teach or suggest any spacers ***1c*** <u>ordinarily</u> spaced from the stacked structure formed on the second substrate ***100A*** to accommodate the liquid crystal layer ***9*** therebetween as the invention.

Moreover, Tanaka tried to solve a prior art problem of interposing glass fibers ***12*** as spacers between glass substrates ***1, 16*** (p. 4, line 24 – p. 5, line 9 of the translation).

> "*As described above, in sticking the upper and lower plates to each other, when a spacer material made of glass fiber is generally used in order to keep a gap between the upper and lower plates fixed, as shown in Fig. 1, a portion where the glass fiber gets over the a-Si TFT occurs at a certain probability. For example, when glass fibers are distributed at a density of 10/mm^2 in a display screen, taking the size of one pixel as 200 μm x 200 μm, 25 pixels are existent in 1 mm^2. Therefore, when the area of a-Si TFT in one pixel is considered to be about 10% of one pixel at maximum, getting-over is caused at probability of one in 25 pixels.*
>
> *When upper and lower plates are stuck to each other using a sealant, thermal load about 1kg/cm^2 at 150°C is applied to form a gap. At the time, in the case where the above getting-over occurs, a great load is applied specifically to that part. Since the glass fiber has Mohs' hardness of 55, it is harder than the TFT element, and also the compressibility per 1kg/cm^2 is generally low as much as 2 to 3 x 10^{-6}% so that deformation is hardly caused, the rate of occurrence of crushing of the TFT element becomes high.*"

To overcome such the problem, Tanaka prevents breakage of the TFT caused by glass fiber occurring in the process of sticking the upper and lower plates **28, 21** to each other by:

> "*In order to solve the problems, in the manufacturing method for a liquid crystal display device of the invention, as shown in Fig. 2, plastic spherical beads **26** having high compressibility and high thermal deformability are used on a display screen area **23** where a TFT element and cross-over wiring of a scan line and a signal line are disposed glass fibers **25** are dispersed in a sealant **24** for sticking an upper plate **21** and a lower plate **28** on an area **22** where a leading wiring is existing, and thermal load is applied to stick the plates to each other.*
> *[Operation]*
>
> *According to the method, the glass fiber **25** in the sealant having low compressibility and causing little thermal deformation and pressure deformation is mainly in charge of forming the whole gap between the upper plate **28** and the lower plate **21**, and the plastic beads **26** having a high compressibility and a little thermal deformability are in charge of forming a gap of a screen display part. In a terminal leading area **22**, even if the glass fiber is used, the above problem is not caused because there is neither cross-over part of the scan line and the signal line nor TFT. Further, it is possible to make the best use of advantage that the gap forming performance of the glass fiber is superior to that of the plastic beads. That is, Fig. 3 shows an example of examining the gap space characteristic to the spacer dispersion density in the case of using the spacers of the glass fiber and the plastic beads having a diameter of 7 μm. It is found that while the plastic beads have the weak point in reproducibility of gap forming because the gap space has a large dispersion density dependency (a curve (a) in Fig. 3), with the spacer of the glass fiber, gap space with good reproducibility can be obtained at*

a dispersion density lower than that of the plastic spacer by ten times (a curve (b) in Fig. 3).

*Fig. 4 shows a sectional view in the case where the plastic spherical spacers dispersed in the display screen part accidentally get on the a-Si TFT element part. In this case, since the plastic spacers has high compressibility and a little thermal deformability, the spacers which have been spherical before application of thermal load as indicated by a reference numeral **17** in Fig. 4 are deformed as indicated by a reference numeral **18** after application of thermal load to thereby prevent crushing of the TFT element. The use of spherical plastic beads can produce the effect of lowering the probability that the plastic spacer gets on the TFT element.*" (p. 5, line 25 – p. 6, line 29 of the translation; Figs. 3, 4)

*As shown in Fig. 4, however, in the case where the plastic bead **17** accidentally gets on a plastic bead **17**, excessive pressure is applied to the beads and the TFT element part. In the method of the invention, however, since the plastic beads 17 have the compressive characteristic to be contained in the oblique line part in Fig. 5, the beads are deformed as indicated by the reference numeral **18**, the TFT element is not crushed. Even in the case of a liquid crystal panel whose number of pixels in the display screen part is 640 x 600 = 384, 000 pixels, for example, when the glass fibers are used in the display screen part, breaking of the TFT element occurs at the probability of 10/380,000 pixels. In the case of the plastic beads, however, it is confirmed that the probability can be lowered to 1/380,000 or smaller. Further, as shown in Fig. 2, glass fibers **25** having favorable gap forming characteristic (Fig. 3) are used in a sealant **24** on a terminal wiring part **22**, so the uniformity of the gap space between the upper plate and the lower plate can be obtained with good reproducibility.*" (p. 8, line 25 – p. 9, line 8 of the translation; Figs. 2-5)

As described above, Tanaka uses the plastic spherical beads **26** as spacers to be disposed on the display screen area **23** due to their high compressibility, a little thermal deformability, and spherical shape (reference numeral 17 in Fig. 4) thereof deformed as indicated by the reference numeral **18** on such the stacked structure as shown in Fig. 4. However, Tanaka prevents spacers 26 from being disposed on either cross-over part of the scan line and the signal line or TFT in order to prevent crushing the TFT element. On the contrary, the first spacers ***1b*** of the present invention, as now recited in claim 8, are intentionally formed on the first substrate ***100B*** to contacts directly with the stacked structure formed on the second substrate ***100A*** and to be formed on the *cross-over part of* the first signal line ***104*** and the second signal line ***103***. It is well established that a rejection based on cited references having principles that teach away from the invention is improper.

Applicants contend that neither Sugata, Nomoto, Tanaka, nor their combinations teaches or discloses each and every feature of the present invention as disclosed in independent claim 1. As such, the present invention as now claimed is distinguishable and thereby allowable over the rejections raised in the Office Action. The withdrawal of the outstanding prior art rejections is in order, and is respectfully solicited.

In view of all the above, clear and distinct differences as discussed exist between the present invention as now claimed and the prior art references upon which the rejections in the Office Action rely, Applicants respectfully contend that the prior art references cannot anticipate the present invention or render the present invention obvious. Rather, the present invention as a whole is distinguishable, and thereby allowable over the prior art.

Favorable reconsideration of this application is respectfully solicited. Should there be any outstanding issues requiring discussion that would further the prosecution and allowance of the above-captioned application, the Examiner is invited to contact the Applicants' undersigned representative at the address and phone number indicated below.

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